GEOPHYSICAL MODEL OF OLYMPIC DAM

COX AND SINGER MODEL NO. 29B — Compilers - **D.B. Hoover, L.E. Cordell**

Geophysically similar models-No. 10 Carbonatites; No. 12, Diamond pipes

A. Geologic Setting

- Pipe-like structure emplaced within Proterozoic anorogenic alkali-granite basement, along a regional basement fracture system.
- Deposit has 350 m of unmineralized late Proterozoic and Cambrian sedimentary cover.
- Model covers only one deposit, has been subject to significant modification since discovery, and is probably still subject to change.
- Commodities are Cu, U, and Au.

B. Geologic Environment Definition

Deposit is on the Stuart shelf in the extreme northwest part of the Adelaid geosyncline, emplaced within the Gawler craton. The Adelaid geosyncline is inferred to be a failed rift, that partially opened in the south (White, 1983). The syncline is defined geophysically by a central gravity high with flanking lows, and bounded by sub-parallel lineaments seen in gravity, magnetic, and remote sensing data. The deposit is located at the intersection of a major west-northwest trending photolineament, and a north-northwest trending gravity lineament (Roberts and Hudson, 1983).

C. Deposit Definition

Originally defined by coincident gravity (-18 mgal) and broad magnetic (+1000 nT) anomalies. Discovery site selection was based on lineament analysis, and coincidental gravity and magnetic anomalies from sources shallow enough to test by drilling. Original exploration model was based on a basaltic Cu model (Cox and Singer model no. 23), where the magnetic high was believed due to extensive basalts, and the gravity high due to a basement horst block within the volcanics (Rutter and Esdale, 1985). However, predicted depths to the anomalous magnetic and gravity sources were 2000 m, and 1150 m respectively, raising some initial questions about the model. Seismic reflection data identified a strong reflector at 350 m, that suggested the source might be shallow. After discovery, gamma-ray logging showed that uranium content was very high, to 600 ppm, thus the deposit if not covered would be detectable by its Radioelement signature. The deposit is also characterized by low resistivity and increased polarization relative to the host granite.

D.

Size and Shape of	**Shape**	**Average Size/Range**
Deposit	Vertical cylinder	Diam. 3 km; height >800 m
Alteration haloe	Irregular	Dolerite in pipe least affected, not geophysically significant?
Cap	Not present	----------

E.	**Physical Properties** (units)	**Deposit** Alkalic-granite + hematite breccia pipe	**Alteration** chlorite, hematite quartz	**Cap** none	**Host** anorogenic alkalic-granite
1.	Density (gm/cm^3)	3.5 average 3.0-4.5[1]	?		2.67?
2.	Porosity	medium high?	?		low
3.	Susceptibility (cgs)	$8x10^{-3}$ average $2x10^{-4}$-$3x10^{-3}$[1]	?		?
4.	Remanence	?	?		?
5.	Resistivity (ohm-m)	high variable 0.1-100's[1,3]	?		?
6.	IP Effect (mv-sec/V) (mradians)	 60-average[1] 20-120[3]	?		low
7.	Seismic Velocity (km/sec)	low	?		high
8.	Radioelements K (%) U (ppm) Th (ppm)	 high? 440 to 640[5] ?	 ? ? ?		 ? ? ?
9.	Other heat-flow (mw/m^2)	 120-275[2]			 66-82[2]

F. Remote Sensing Characteristics

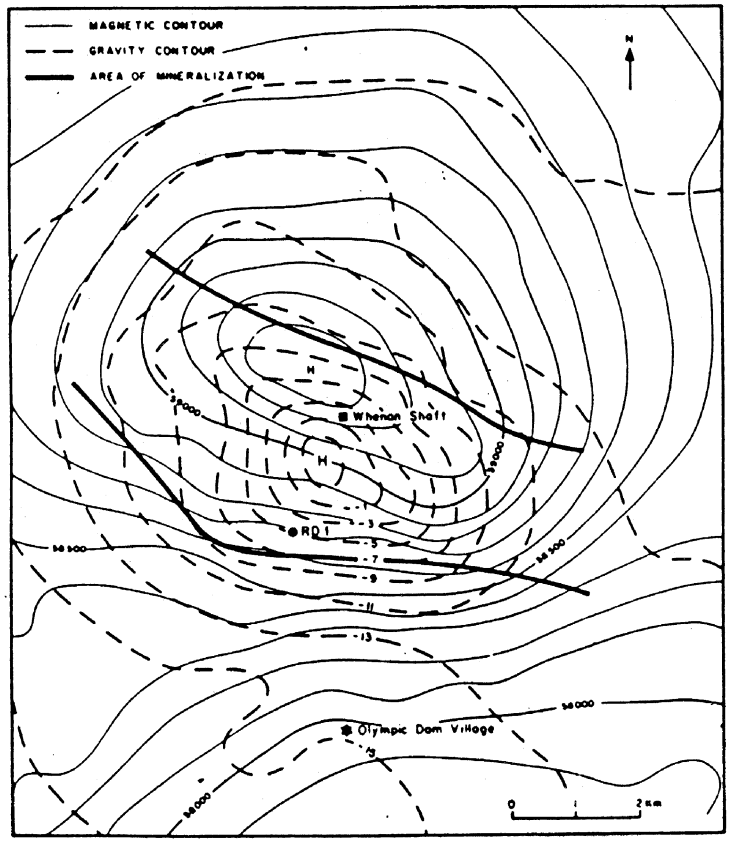
Visible and near IR--Presence of a major, broad (up to 48 km wide), continental lineament important in original area selection (0'Driscoll and Keenihan, 1980). If not covered, hematite, chlorite, sericite, and silica alteration should be definable.

G. Comments

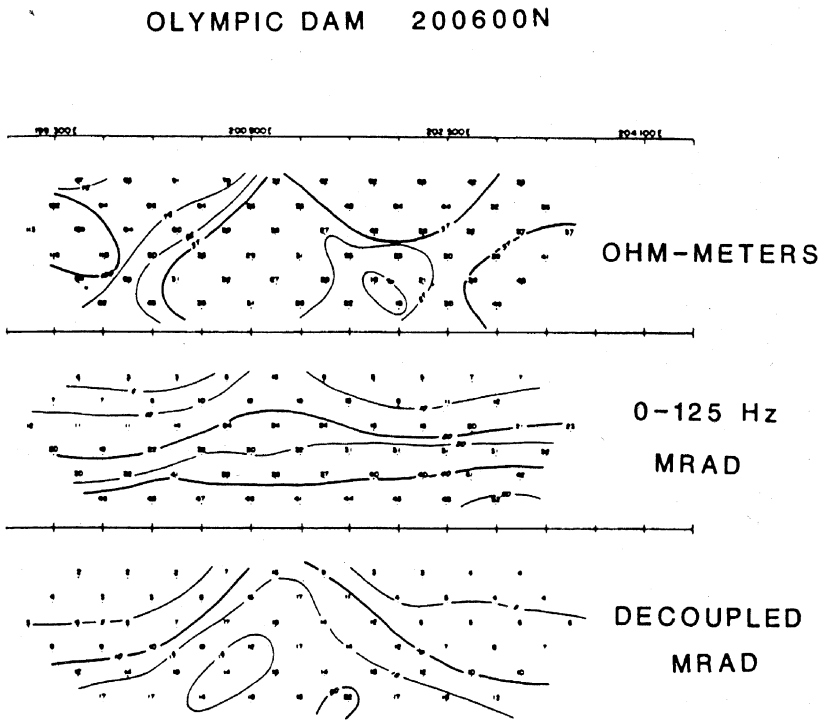
The gravity anomaly is explained by the presence of the hematite-rich breccia. The source of most of the magnetic anomaly is deeper than presently explored (1150 m), but generally assumed directly related to the deposit. The high heat flow is due to the highly elevated uranium content. The geophysical signature of this single deposit is indistinguishable from that of carbonatites and similar to that of diamond pipes.

H. References

1. Ballantine, E., 1989, Advisory system for selecting the proper geophysical techniques for mining exploration: Univ. of Missouri, Rolls, unpublished Ph.D. thesis, 121 p.
2. Cull, J.P., Houseman, D.J., Muir, P.M., and Paterson, H.L., 1988, Geothermal signatures and uranium ore deposits on the Stuart Shelf of South Australia: Exploration Geophysics, v. 19, p. 34-38.
3. Esdale, D.J., Pridmore, D.F., Coggon, J.H., Muir, P.M., Williams, P.K., and Fritz, F.P., 1987, Olympic Dam deposit--Geophysical case history: Exploration Geophysics, v. 18, p. 47-49.
4. O'Driscoll, E.S.T., and Keenihan, S.L., 1980, the Toowoomba-Charleville lineament in southern Queensland: Australian Petroleum Explor. Assoc. Journal, v. 20, p. 16-24.
5. Roberts, D.E., and Hudson, G.R.T., 1983, The Olympic Dam copper-uranium-gold deposit Roxby Downs, South Australia: Economic Geology, v. 78, no. 5, p. 799-822.
6. Rutter, H., and Esdale, D.J., 1985, The geophysics of the Olympic Dam discovery: Exploration Geophysics, v. 16, p. 273-275.
7. White, A.H., 1983, Speculations on the Adelaid rift and the origin of diapirs [abs.]: Australian Mineral Foundation Symposium, Adelaid, p. 3-6.



A



B

Figure A. Gravity and magnetic anomalies at Olympic Dam, Australia. Area of mineralization is located between the dotted lines. Adapted from Roberts and Hudson (1983).

Figure b. Induced polarization section across the Olympic Dam deposit. Adapted from Esdale and others (1987).